# GRBs, Fireballs and Precessing Gamma Jets

Daniele Fargion[1,2]

Universitá degli Studi di Roma I, *LaSapienza*[1] and $INFN^2$,
Piazzale Aldo Moro 5 , 00185,Rome,Italy

**Abstract.** Fireballs are huge isotropic explosions models widely believed to explain Gamma Ray Burst, GRBs (Piran,1999); ever-new versions consider wide beamed ($10^o$) Jet explosions hitting external shells. On the contrary, since 1994-1998, we argued (Fargion 1995-2000; see also Blackman et all.1996) that GRBs (as well as Soft Gamma Repeaters SGR) are spinning and precessing Gamma Jets, produced by collimated $e^+$,$e^-$ Jet via Inverse Compton Scattering, in a very narrow ($0.1^o$) angles, blazing and flashing the observer. The Jet arises in Super-Nova (SN) explosions; its energy decays slowly from earliest SN powers (corresponding to GRB) toward lower stable power as Soft Gamma Repeaters (SGR) regimes. GRBs and SGRs shared (sometimes) same spectra and time structure: then SGRs are low-power GRBs, but without SN relics (or GRB afterglows, signatures of Jets in SN-GRBs). Moreover weak isolated X-ray precursor signals,(such as $GRB$980519, $GRB$981226, $GRB$000131), corresponding to huge isotropic $\sim 10^{47}$ erg $s^{-1}$, followed by the extreme GRB $\sim 10^{52}$ erg $s^{-1}$ powers, disagree with any Fireball explosive scenarios. We naturally interpret these X-Ray precursors as rare earliest marginal blazes of outlying X conical precessing Jet tails, surrounding the $\gamma$ Jet, later hitting in-axis as a GRB.

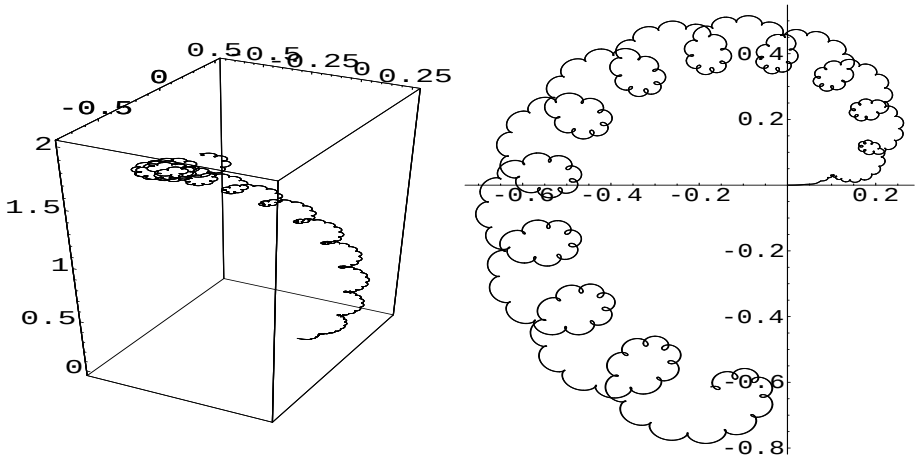


**Fig. 1.** Left: Three dimensional space evolution of a Spinning while Precessing X -$\gamma$ Jet, leading by its blazing to X precursor and to the main $\gamma$ GRB. Right: The same jet pattern observed from above along the vertical axis , on a two dimensional plane.

Since $GRB980425$ we argued (Fargion 1998-2000) that GRBs and SGRs can be explained by a comprehensive theory where a thin (tens of seconds) $\gamma$ beam Jet, spinning in multi-precession, is sprayed by a Neutron Star, NS, or a Black Hole, BH, flashing and blazing the observer. Indeed the extreme energy released in GRB990123 and GRB000131, ($\gg 10^{54}\ erg$), (or even twice as much, keeping into account neutrino budget) leads to a conflict with any isotropic GRB model: Schwarzschild scale times (corresponding to the needed solar masses ), above milliseconds, disagree with the observed GRBs fine time structures (below a fraction of millisecond). GRBs and SGRs share, in a few cases, the same spectra (Fargion 1998-1999-2000;Wood et all 1999) and time structure, suggesting an unique model. The $\gamma$ Jet for GRB and SGR is produced, trough Inverse Compton Scattering (ICS), by GeVs $e^+$ $e^-$ (secondaries of penetrating GeVs $\mu^+$ $\mu^-$), scattering on infrared photons, (Fargion,Salis 1995-1998), leading to a collimated, spinning and precessing $\gamma$ (MeVs) precessing Jet.

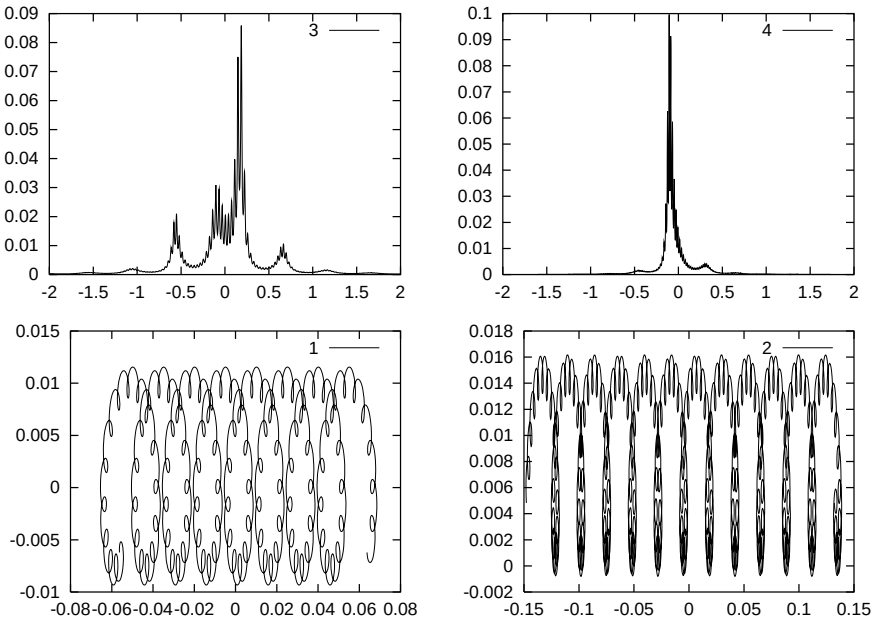


**Fig. 2.** Lower figures show two different angular Jet patterns , as traced in Fig.1. Their bi-dimensional opening angles while Spinning and Precessing, are blazing the observer at the center (origin $(0,0)$) leading, by ICS, to the consequent GRB signal described above. Upper figures show the the consequent X, GRB intensity evolution (time in secs) derived by the ICS formula and the corresponding geometrical Jet patterns evolutions below. The X ray precursor may naturally arise in some pattern configurations.

The peak $\gamma$ Jets has power of a Supernova ($10^{44} ergs^{-1}$) appearing beamed as ($10^{52} ergs^{-1}$) decaying by power law $\sim t^{-1}$ in 3-6 hour scale times, to ancient,

lower power SGRs stages. SGRs are powered by X-ray pulsars Jet ($10^{35} ergs^{-1}$) whose collimated beam is amplified up to ($10^{43} ergs^{-1}$). Both of GRB and SGR show an apparent luminosity amplified by the inverse of the beamed solid angle ($10^7 - 10^9$). The earliest and puzzling X-Ray precursors in few GRBs (as well as SGRs) is an obvious peripherical off-axis flashing followed by main in-axis GRB blaze, in some geometrical configurations, as shown in simulations in Fig.2. Data on X-Ray precursor and GRB are shown for comparison in Fig3.

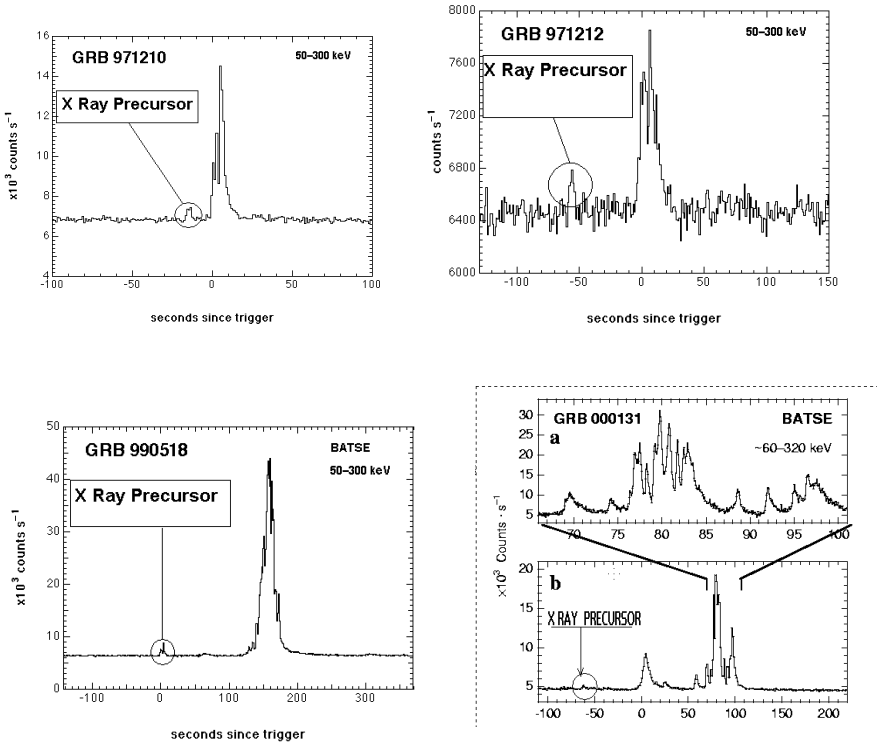


**Fig. 3.** Up: Time evolution and X precursors in GRB 971210 and GRB 971212. Down: The same evolution in GRB 990518 and in most distant (red-shift 4.5) GRB 000131; note the (surprising for Fireball) tiny X-Ray precursor a minute before the main GRB.

## References

1996. Blackman, E: G., Yi, I., Field G. B.: 1996, ApJ 479, L79-L82
1995. Fargion, D., Salis, A.: 1995, Nuc. Phys B,43, 269-273; As.& Spac.Sc.231,191-194.
1998. Fargion, D., Salis, A.: 1998,Physics-Uspekhi, 41(8), 823-829
1999-2000. Fargion, D. 1999, A & A, 138, 507; astro-ph/0011403.
1999. Woods P.M.et all. astro-ph/9909276